APPENDIX C

PATRICK MANUFACTURING, INC.

THE MIDWEST'S LEADING CU
SPRING, WIREFORM & STAN
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GLOSSARY

Glossary of Spring Terminology

Active Coils (n_a) C

Those coils which are free to deflect under load.

Angular relationship of ends

The relative position of the plane of the hooks or loops of extension springs or the legs of a torsion spring to each other.

Baking

Heating of electroplated springs to relieve hydrogen embrittlement.

Buckling

Bowing or lateral deflection of compression springs when compressed, related to the slenderness ratio (Free Length/Mean Coil Diameter).

Closed ends and squared

Ends of compression springs where pitch of the end coils is reduced so that the end coils touch and are square with the spring axis.

Closed and ground ends

As with closed ends, except that the end is ground to provide a flat plane.

Closed length

See Solid height

Close-wound

Coiled with adjacent coils touching.

Coils per inch

See Pitch.

Deflection (F)

Motion of spring ends or legs under the application or removal of an external load (P).

Elastic limit

Maximum stress to which a material may be subjected to without permanent set.

Endurance limit

Maximum stress at which any given material will operate for a determined number of cycles without failure for a given minimum stress.

Free angle

Angle between the legs of a torsion spring which is not under load.

Free length (L)

The overall length of a spring which is not under load.

Gradient

See Rate (R).

Heat setting

Fixturing a spring at elevated temperature to minimize loss of load at operating temperature.

Helix

The spiral form (open or closed) of compression, extension, and torsion springs.

Hooke's Law

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Load is proportional to displacement.

Hooks
Open loops or ends of extension springs.

Hot pressing
See Heat Setting.

Hydrogen embrittlement
Hydrogen absorbed in electroplating or pickling of carbon steels, tending to make the spring material brittle and susceptible to cracking and failure, particularly under sustained loads. Proper baking is required to relieve the hydrogen.

Hysteresis
The mechanical energy loss that always occurs under cyclic loading and unloading of a spring, proportional to the area between the loading and unloading load-deflection curves within the elastic range of a spring.

Initial tension (P_i)
The force that tends to keep the coils of an extension spring closed and which must be overcome before the coils start to open.

Load (P)
The force applied to a spring that causes a deflection (F).

Loops
Formed wire shapes at the ends of extension springs that provide for attachment and force application.

Mean coil diameter (D)
Outside spring diameter (OD) minus one wire diameter (d).

Modulus in shear or torsion (G)
Coefficient of stiffness for extension and compression springs. (Modulus of Rigidity)

Modulus in tension or bending (E)
Coefficient of stiffness used for torsion and flat springs (Young's Modulus E).

Moment (M)
A product of the distance from the spring axis to the point of load application, and the force component normal to the distance line. See Torque.

Open ends, not ground
End of a compression spring with a constant pitch for each coil and the last coils not touching adjacent coils.

Open ends ground
"Open ends, not ground" followed by an end grinding operation.

Passivating
Acid treatment to remove contaminants and improve corrosion resistance of stainless steel.

Permanent set
A material that is deflected so far that its elastic properties have been exceeded and it does not return to its original condition upon release of load has taken a "permanent set."

Pitch (p)
The distance from center to center of the wire in adjacent active coils (recommended practice is to specify number of active coils rather than pitch).

Plain Ends
End coils of a compression spring having a constant pitch and not squared.

Poisson's Ratio
The ratio of the strain in the transverse direction to the strain in the longitudinal direction.

Preset

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See Remove set.

Rate (R)
Change in load per unit deflection, generally given in pounds per inch. (N/mm)

Remove set
The process of closing to solid height a compression spring which has been coiled longer than the desired finished length, so as to increase the apparent elastic limit.

Residual stress
Stresses mechanically induced by set removal, shot peening, cold working, forming or other means. These stresses may or may not be beneficial, depending on the application of the spring.

Set
Permanent distortion in length, height, or positon which occurs when a spring is stressed beyond the elastic limit of the material.

Shot peening
Blasting the surfaces of the spring with pellets to induce compressive stresses and thereby improve fatigue life.

Slenderness ratio
Ratio of spring length (L) to mean coil diameter (D).

Solid height (H)
Length of a compression spring when under sufficient load to bring all coils into contact with adjacent coils; no additional deflection is possible.

Spring index
Ratio of mean coil diameter (D) to wire diameter (d).

Squared and ground ends See Closed and ground ends.

Squared ends
See Closed ends.

Stress range
The difference in operating stresses at minimum and maximum loads.

Stress relieve
To subject springs to low-temperature heat treatment so as to relieve residual stresses.

Torque (M)
A product of the distance from the spring axis to the point of load application, and the force component normal to the distance line.
A twisting action in torsion springs which tends to produce rotation, equal to the load multiplied by the distance (or moment arm) from the load to the axis of the spring body. Usually expressed in oz./in., lb./in., lb./ft., or in. N/mm.

Total number of coils (N_t)
Number of active coils (N_a). For compression springs, active coils (Na) plus the number of dead coils forming the ends.

Wahl Factor
A factor to correct stress in helical springs effects of curvature and direct shear.

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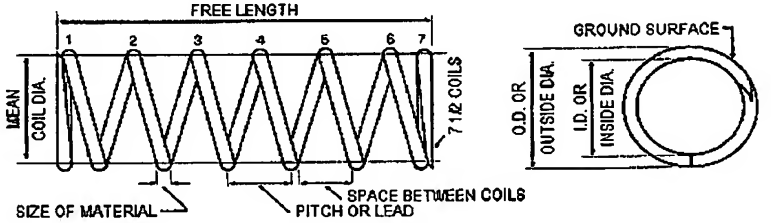
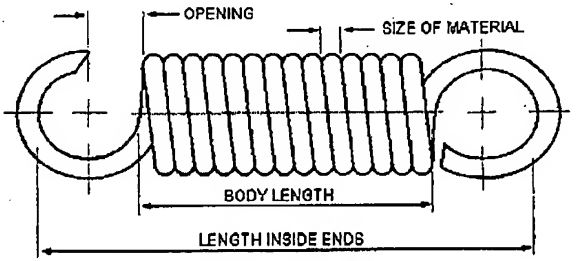


Compression Springs

Helical compression springs have applications to resist applied compression forces or in the push mode, store energy to provide the "push". Different forms of compression springs are produced. There are conical, barrel, hourglass, or straight conical compression springs. These compression springs can be made with or without variable spacing between coils. Round wire springs can store more energy than rectangular wire compression springs.



Extension Springs

Extension Springs exert a pulling force or energy. They are usually close wound with initial tension and are mostly made from round wire. The design of the extension springs' ends are limitless. Hooks, loops, bends, crossbars, etc.

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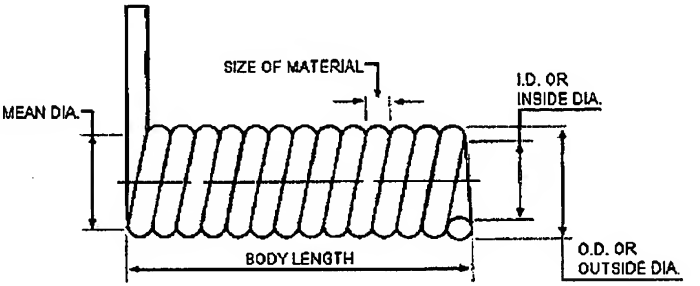

Torsion Springs

A torsion spring provides rotational energy or torque. You can have a single bodied or double bodied torsion spring. You must have three points of support and the body usually sits on a shaft or arbor. Again, the design of the ends or legs of a torsion spring are limitless. The stress in a torsion spring is bending. Round wire is still the preferred material due to the cost of rectangular wire, even though rectangular is more efficient in bending.

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